

REPORT DOCUMENTATION PAGE

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Sea Water Immersion of GEM II Propellant

C. I. Merrill and J. D. O'Drobinak

AFRL

Edwards AFB, CA

TP-1998-076

PA-120084

MEMORANDUM FOR IN-HOUSE PUBLICATIONS

14 Apr 98

FROM: PROI (TI) (STINFO)

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C.I. Merrill and J.D. O'Drobinak "Sea Water Immersion of GEM II Propellant" *VuGraphs*
(Statement A)



Pacific Seawater Aging of GEM Propellant

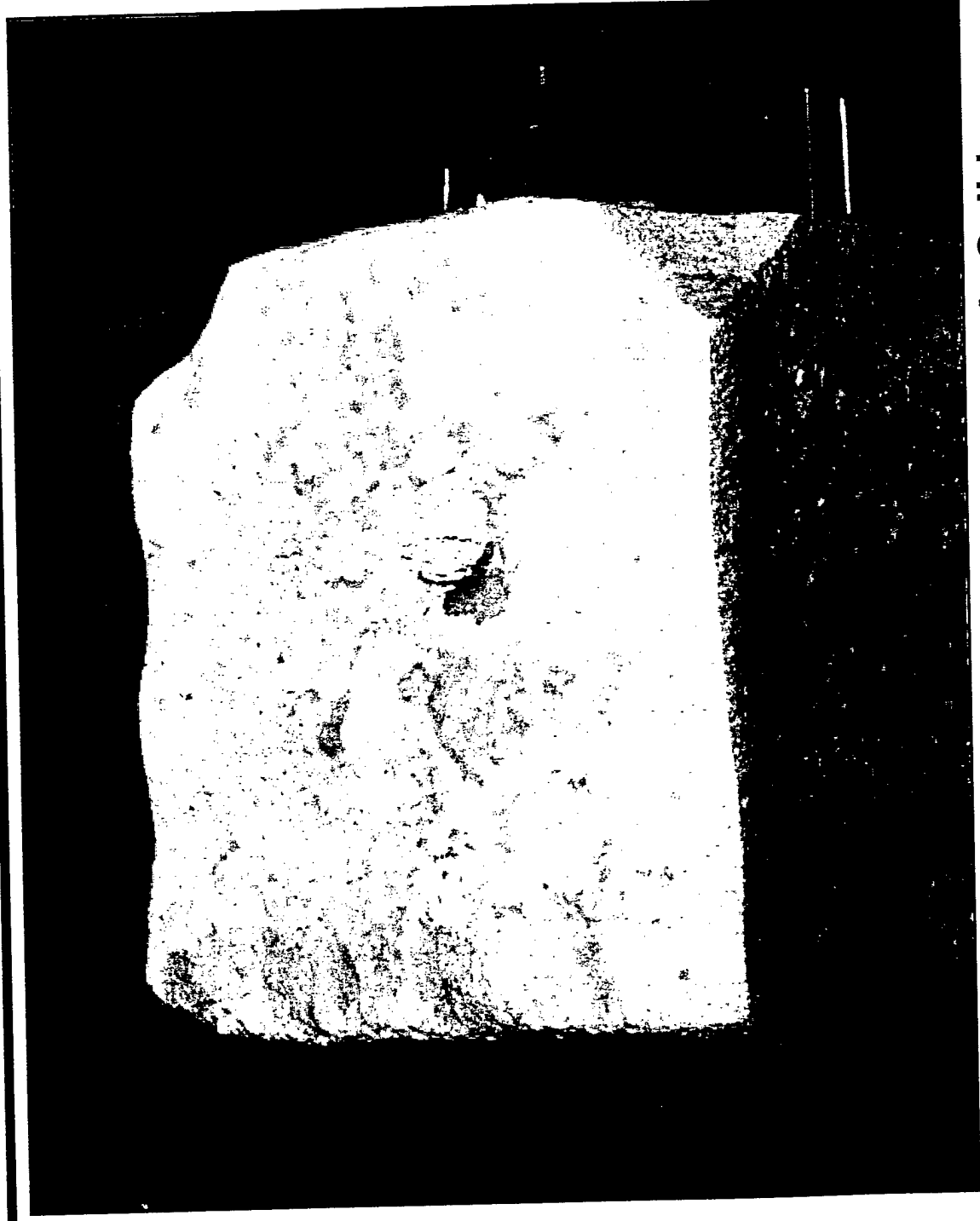
A1008.



Cutting Into Blister Doesn't Cause Deflation



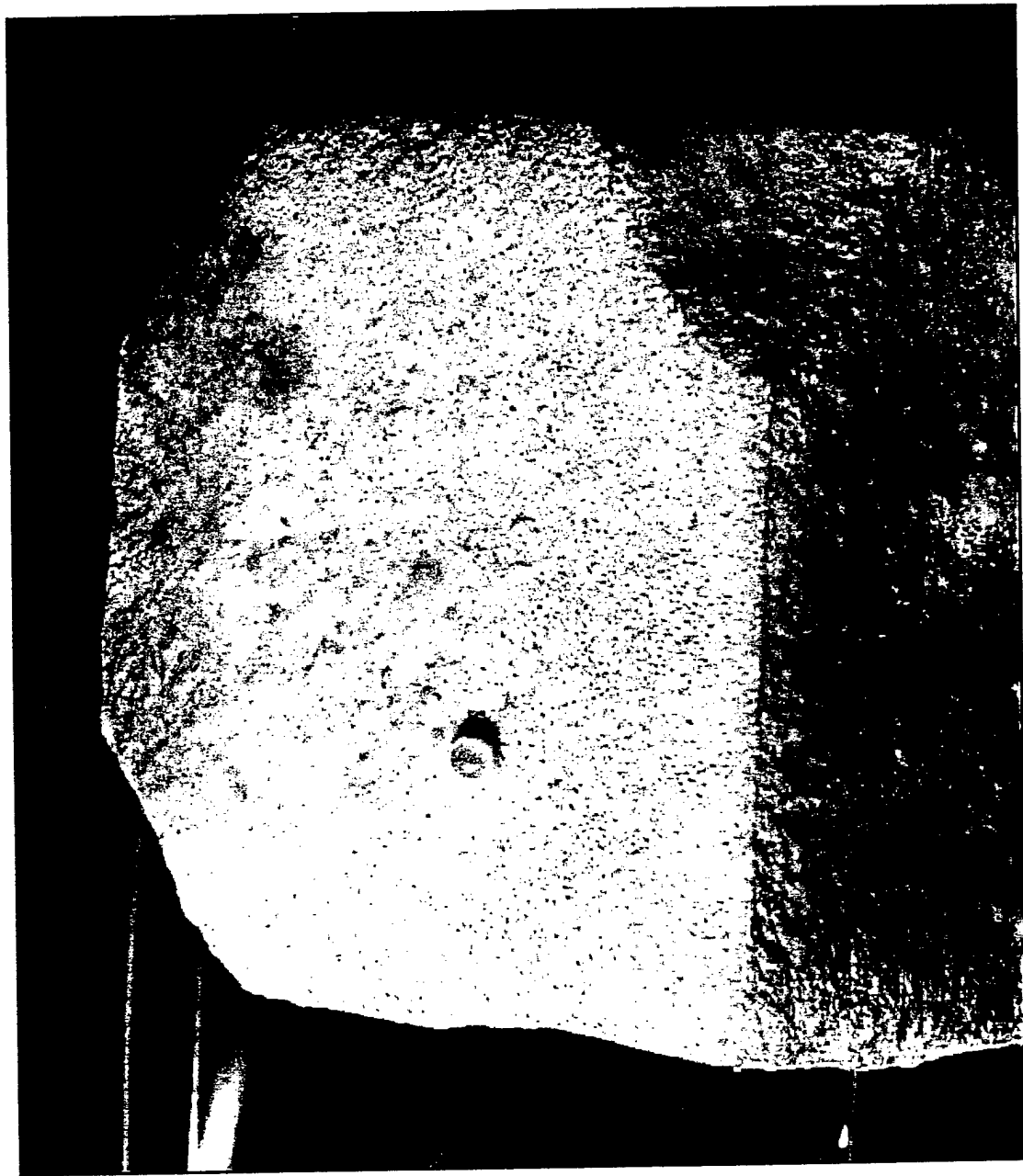
Pacific Seawater Aging of GEM Propellant



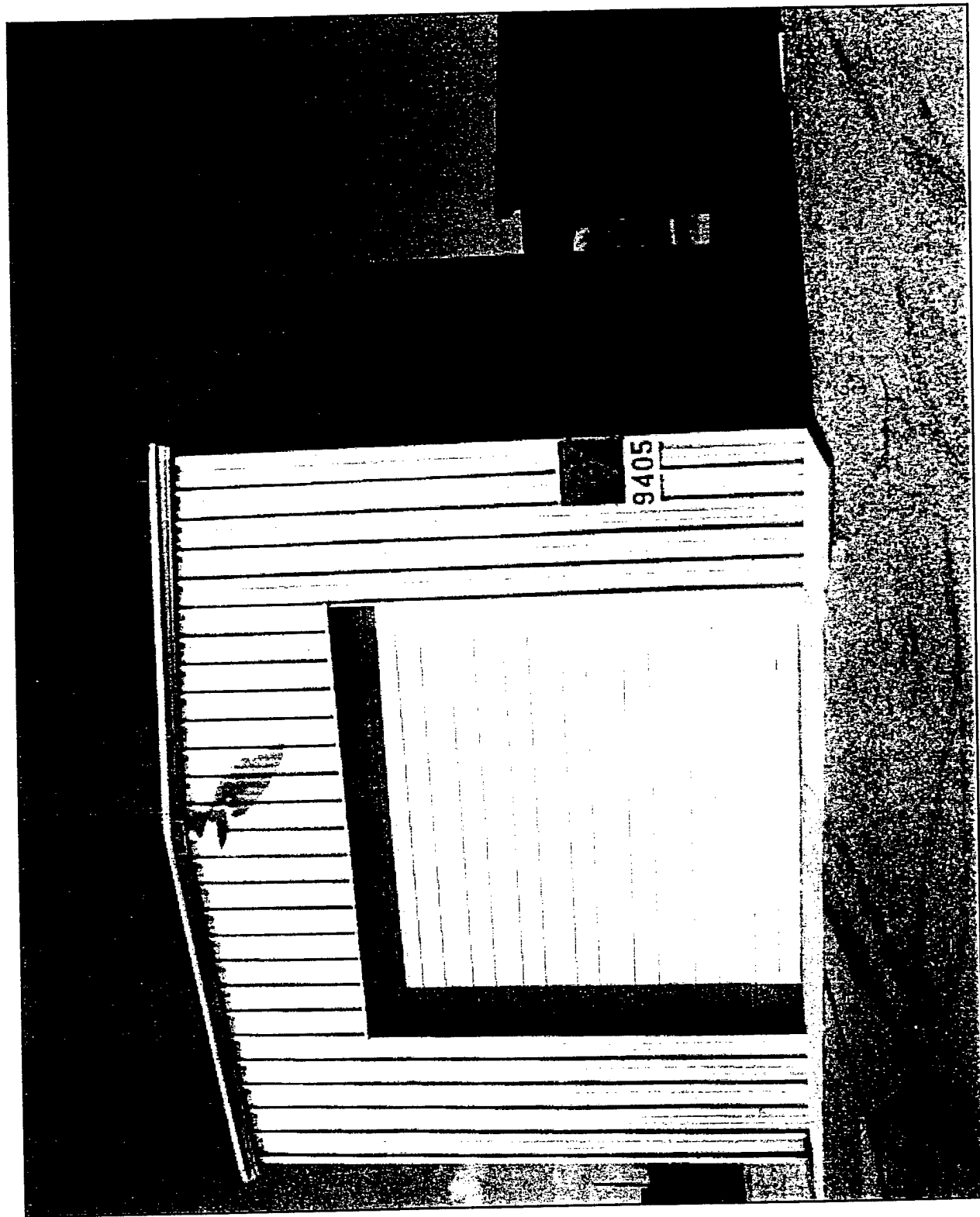
Casting Void Below Blister, Blister Is Solid



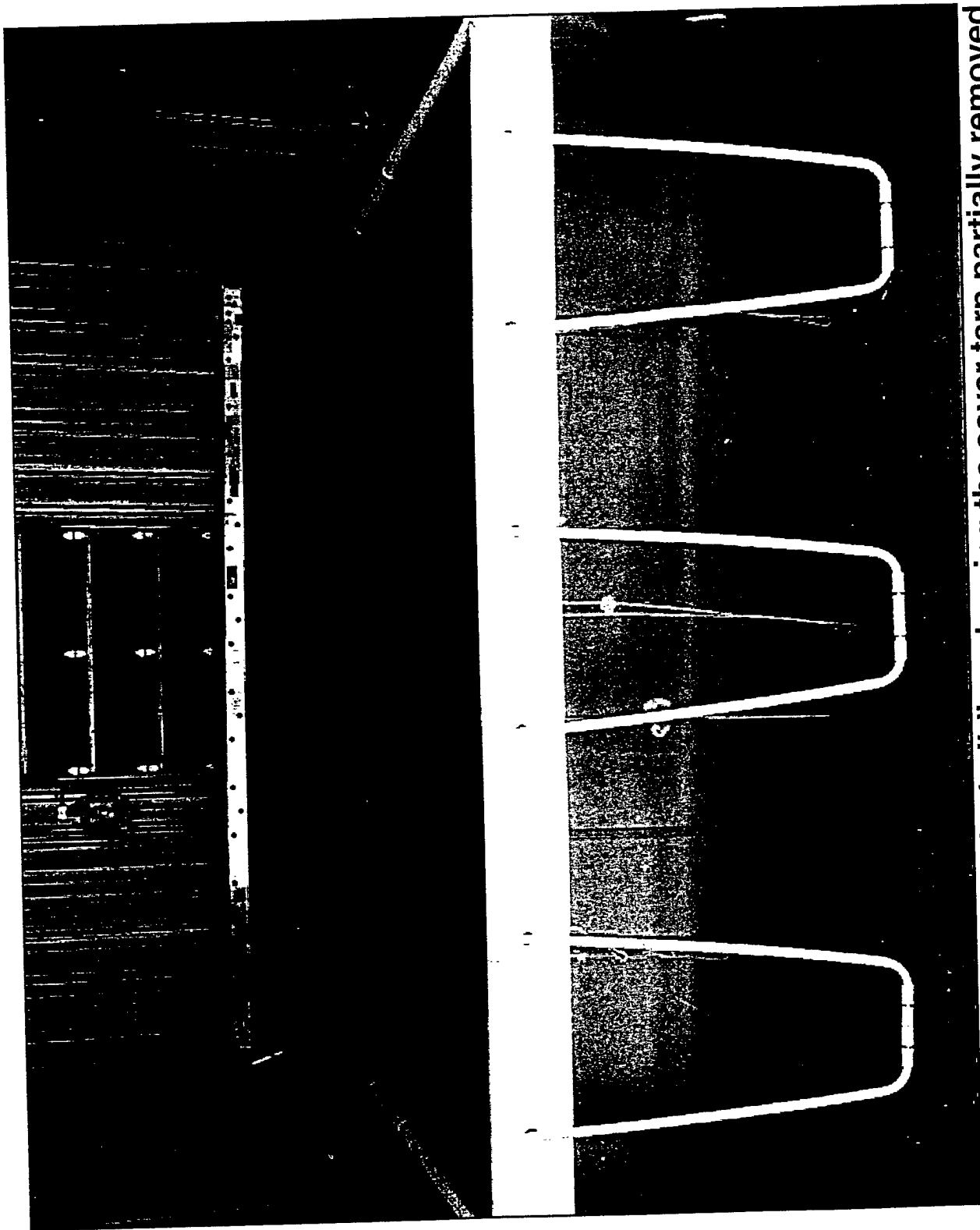
Pacific Seawater Aging of GEM Propellant



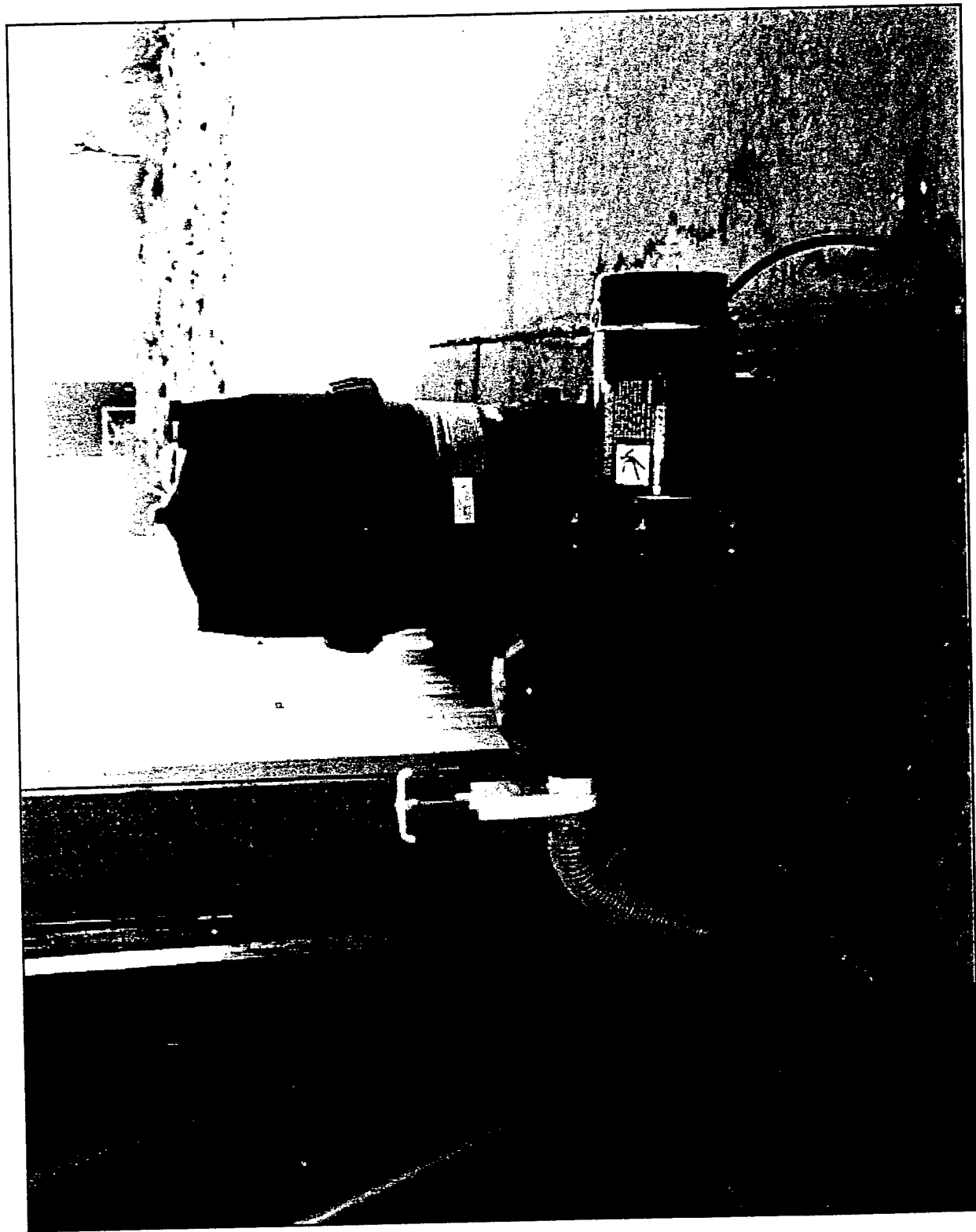
Clear Binder Blister



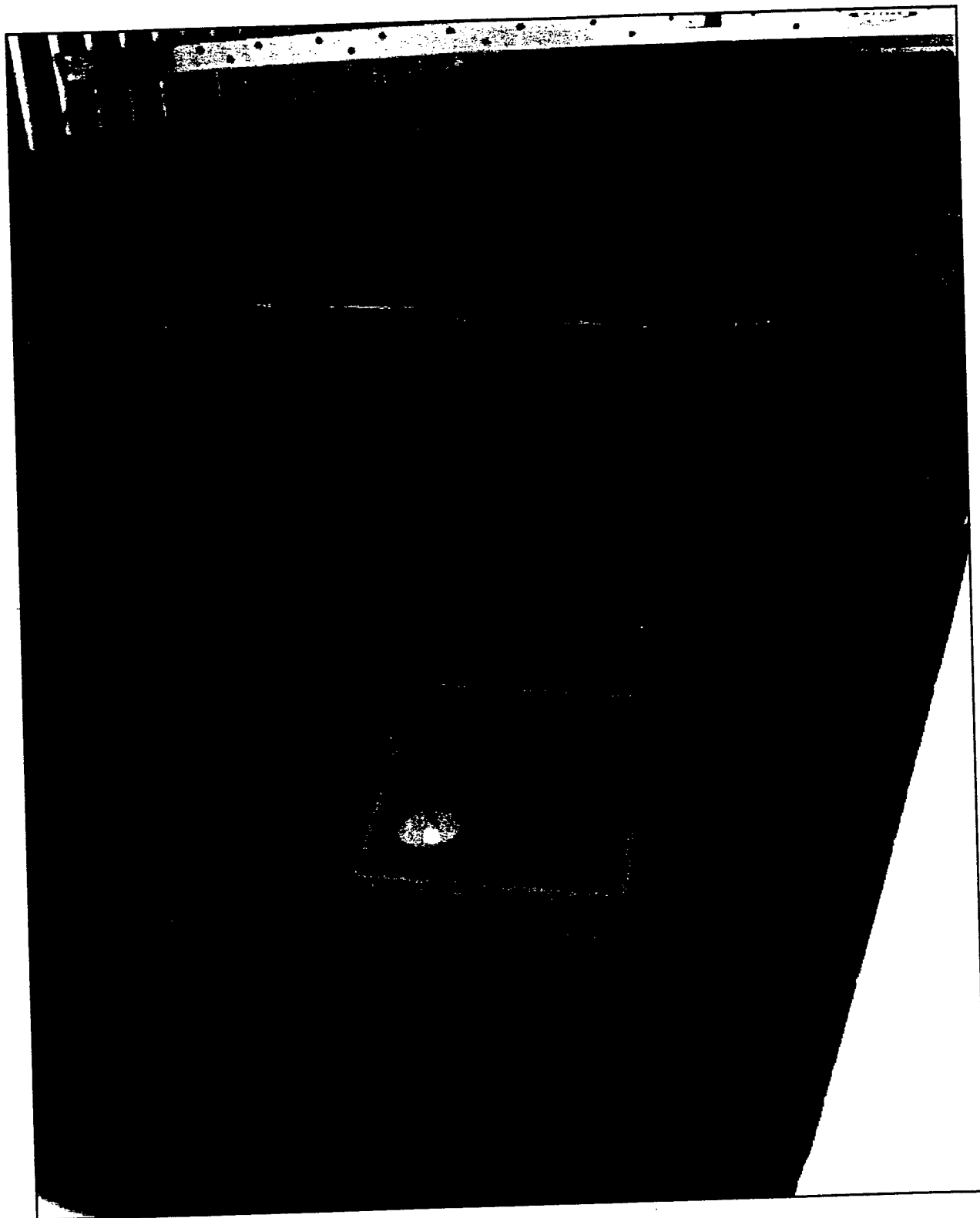
Building in which the aging study is being conducted.



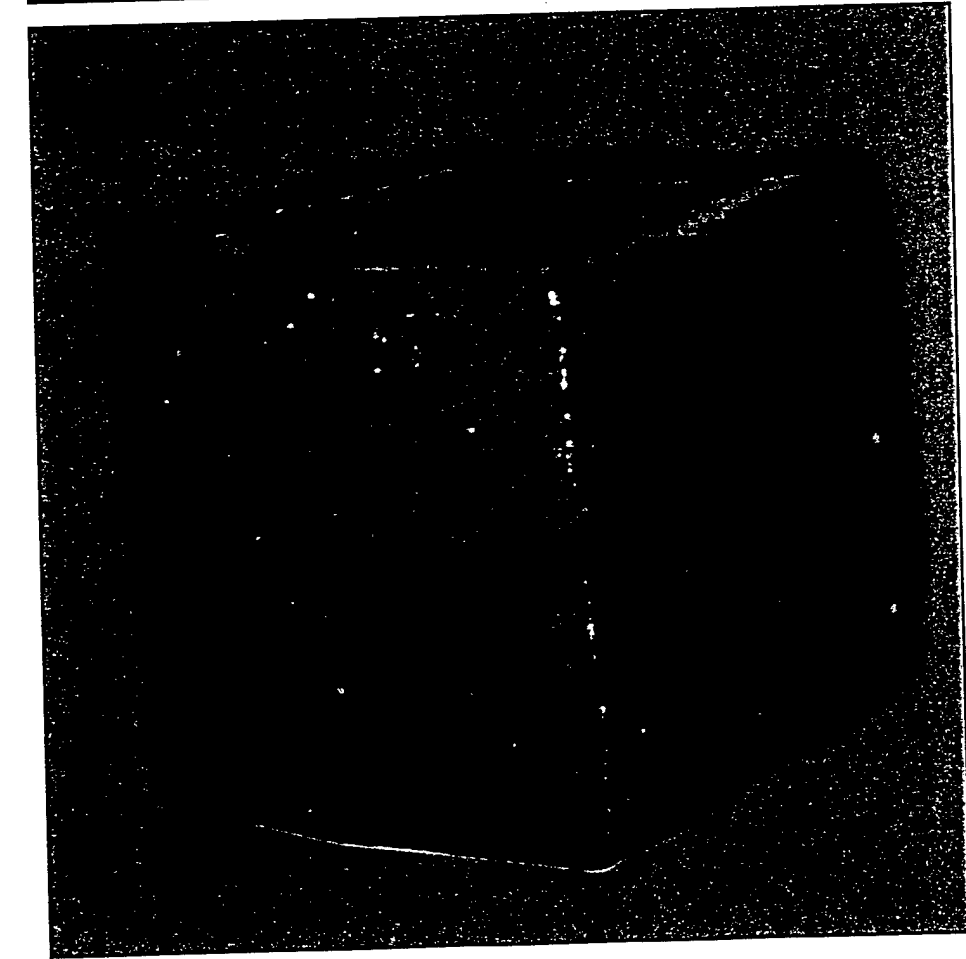
Swimming pool inside the building showing the cover tarp partially removed.
String hanging over the sides of the pool are connected to baskets
containing propellant samples.



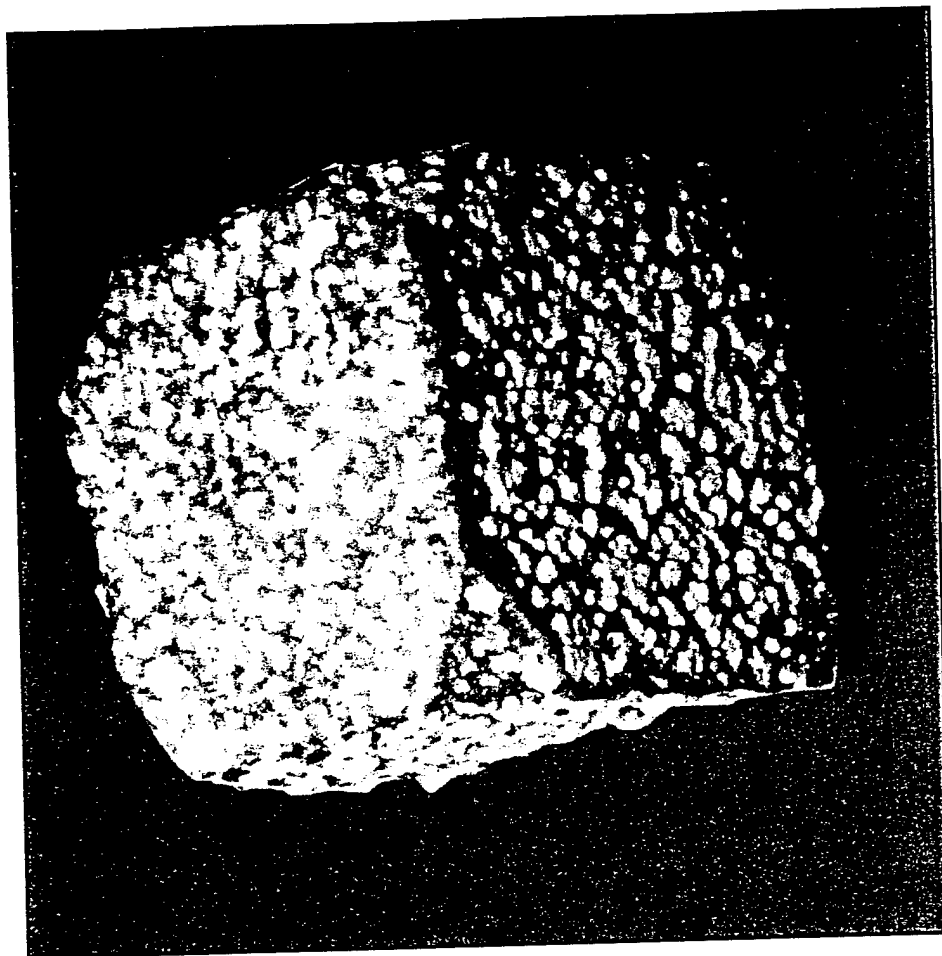
Circulation pump together with hoses connected to swimming pool.



Two baskets containing propellant samples on bottom of pool. Basket on the left contains samples buried in the sand.

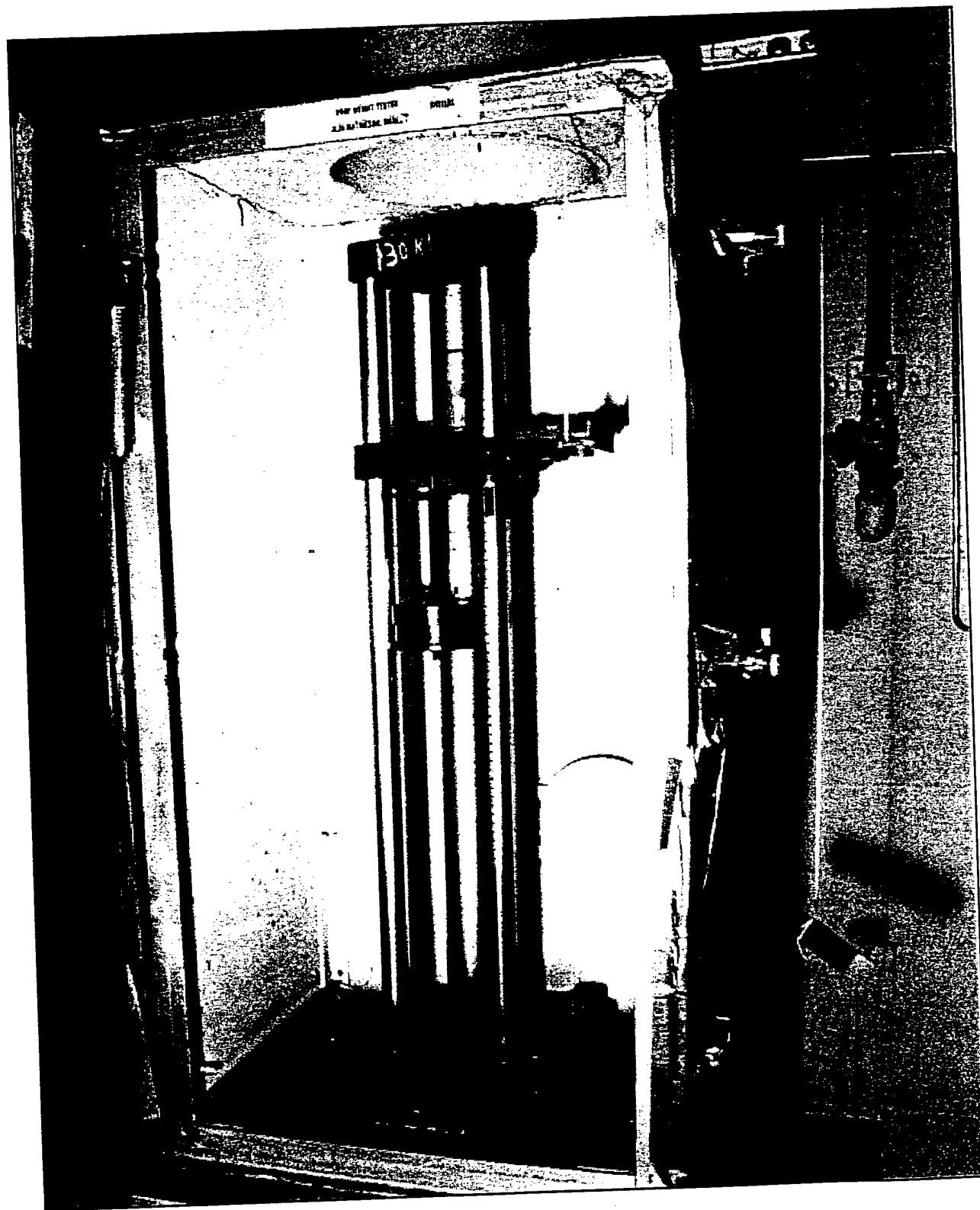


2" Cube / Wet



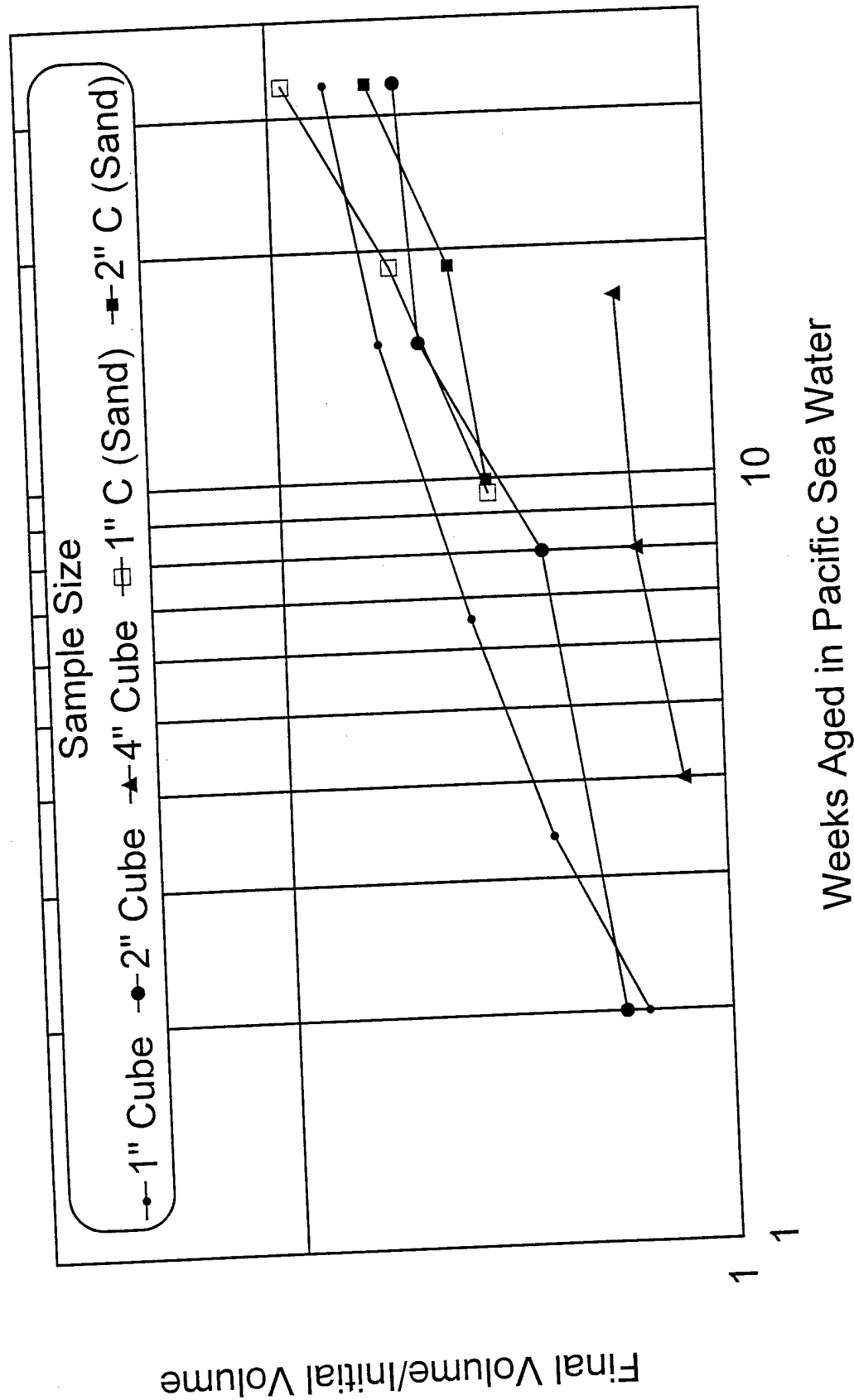
2" Cube / Dry

Representative appearance of wet and dry samples that were aged in the swimming pool.



Drop Weight Impact Tester.

RELATIVE SWELLING RATES OF WET AGED GEM PROPELLANT



EFFECT OF AGING TIME AND SAMPLE SIZE ON FIRE TEST RESULTS

Test	Sample	Aging Water	Cube/State	Soak Time ^a	Time to Burn ^b
1	Control	None	1"/Dry	0.00	0
2	5-5i	S ^c	1"/Wet	1.11	60
3	7	S	1"/Dry	1.11	0
7	2-1i	S	1"/Dry	2.97	0
8	1-1o	S	1"/Wet	2.97	125
15	1-1i	S	1"/Dry	5.12	0
16	3-1i	S	1"/Wet	5.12	225
11	6t	S	2"/Dry	2.08	0
12	3	S	2"/Wet	2.08	90
17	2c	S	2"/Dry	5.12	0
18	1	S	2"/Wet	5.12	>300 ^f
25	2t	S	2"/Wet	5.12	200
26	5	S	2"/Dry	8.69	0
27	0	S	2"/Wet	8.69	270
4	3	C ^d	1"/Wet	1.11	55
5	0	C	1"/Dry	2.97	0
6	5	C	1"/Wet	2.97	115
9	3cc	P ^e	1"/Wet	2.00	225
10	3cd	P	1"/Dry	2.00	0
19	2c-2io	P	1"/Dry	3.43	0
20	3c-1ii	P	1"/Wet	3.43	140
28	4cd	P	1"/Dry	6.97	0
29	5 3(90)	P	1"/Wet	6.97	425
32	2t-3iidd	P	1"/Dry	9.97	0
33	0	P	1"/Wet	9.97	348 ^g
13	6t	P	2"/Dry	2.00	0
14	6c	P	2"/Wet	2.00	60
21	3cc-1i	P	2"/Dry	4.00	0
22	2c-2io	P	2"/Wet	4.00	120
30	2c	P	2"/Dry	8.00	0
31	0-2c	P	2"/Wet	8.00	352
34	3cc-200	P	2"/Dry	9.97	0
35	4ccc-1op	P	2"/Wet	9.97	354
23	3tt	P	4"/Dry	4.00	0
24	6t	P	4"/Wet	4.00	120

a. Time in weeks

b. Approximate time in seconds

c. Simulated seawater

d. Cape Canaveral water

e. Pacific seawater

f. Sample did not burn before fuel flame expired.

g. Fire intensity was greater than that of Test 29.

FRICTION & IMPACT TEST RESULTS OF AGED GEM PROPELLANT

Sample	Cube Size	Aging Time ^a	No Fires	Location/State	Impact, kg-cm	Frict., E, kg-cm
Reference ^b	-	0.00	4 (7)	Dry	93	12.0
0-7	1"	2.00	5 (5)	Skin/Dry	102	9.6
2c-1i	1"	2.00	5 (5)	Skin/Wet	250 ^c	28.8
"	1"	2.00	5 (5)	Center/Wet	132	14.4
3c-2io	1"	3.43	5 (5)	Skin/Dry	108	16.8
3c-3iio	1"	3.43	5 (5)	Skin/Wet	250 ^c	36.0 ^d
"	1"	3.43	3 (5)	Center/Wet	240	21.6
6c	1"	6.97	4 (5)	Skin/Dry	99	14.4
"	1"	6.97	3 (5)	Centre/Dry	96	-
4ccc	1"	6.97	5 (5)	Skin/Wet	250 ^c	36.0 ^d
"	1"	6.97	5 (5)	Center/Wet	141	21.6
2t	1"	9.97	3 (5)	Skin/Dry	96	14.4
"	1"	9.97	4 (5)	Center/Dry	99	-
3c-3ioo	1"	9.97	5 (5)	Skin/Wet	250 ^c	36.0 ^d
"	1"	9.97	5 (7)	Center/Wet	138	28.8
8	2"	2.00	5 (5)	Skin/Wet	250 ^c	32.4
"	2"	2.00	4 (5)	Center/Wet	108	14.4
0-5cccd	2"	4.00	5 (5)	Skin/Wet	250 ^c	36.0 ^d
"	2"	4.00	4 (5)	Center/Wet	105	14.4
1	2"	8.00	5 (5)	Skin/Wet	250 ^c	32.4
"	2"	8.00	4 (5)	Center/Wet	105	14.4
3cc-2ii	2"	9.97	5 (5)	Skin/Wet	250 ^c	36.0 ^d
"	2"	9.97	4 (5)	Center/Wet	114	14.4

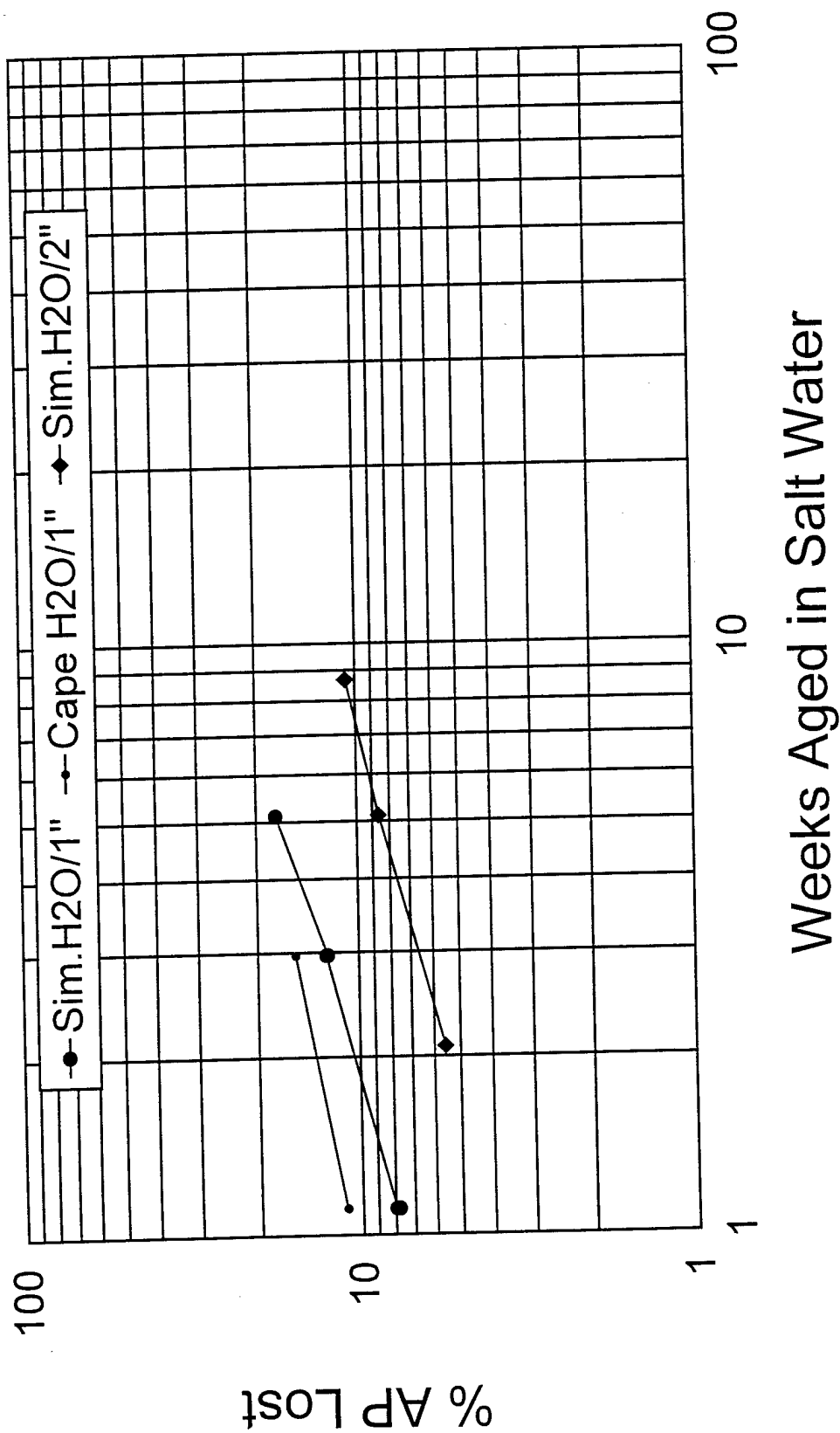
a. Aging time in weeks

b. Propellant was not aged.

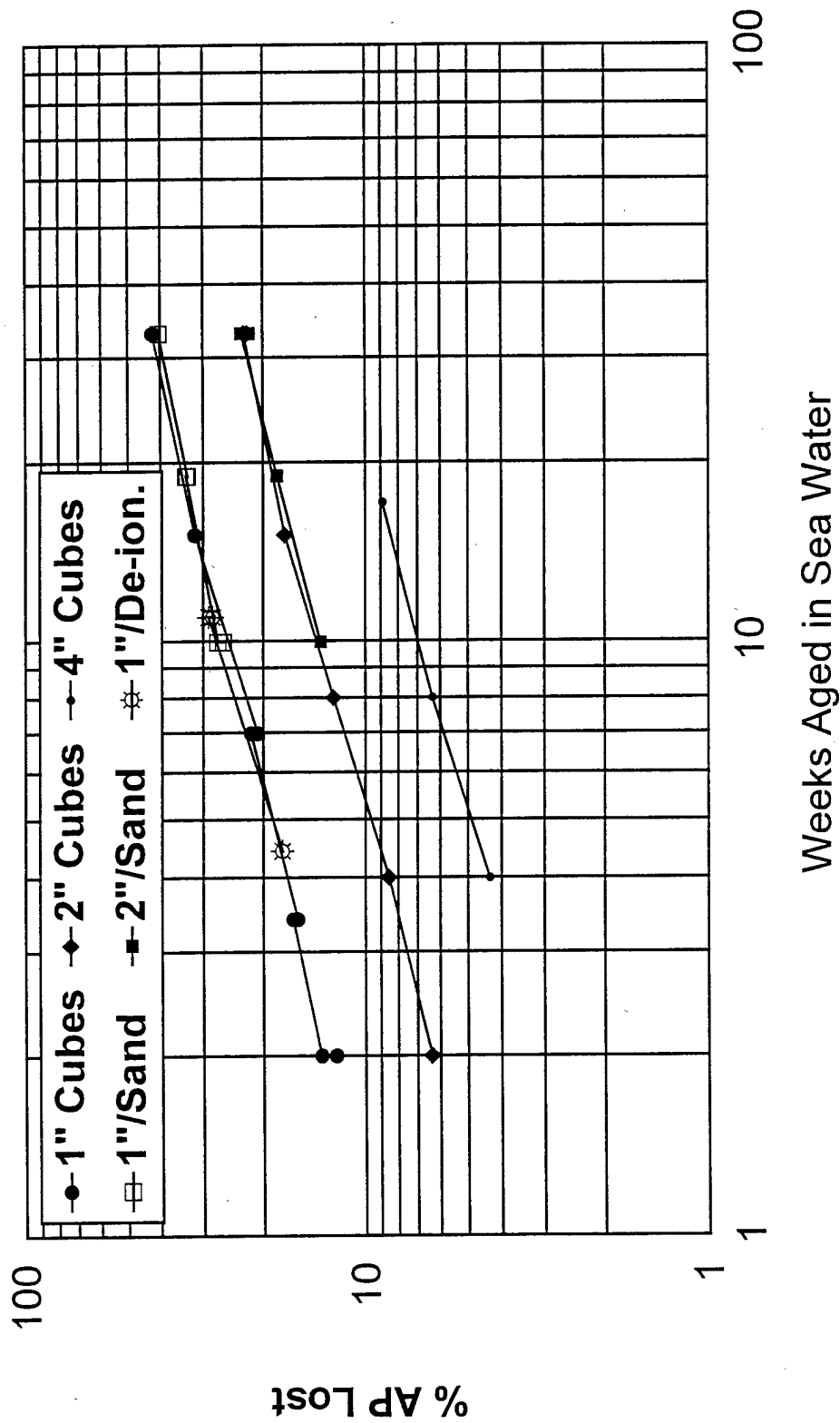
c. 250 kg-cm impact value is upper limit for test.

d. 36.0 kg-cm friction values is upper limit for test.

AP DEPLETION RATES FOR PROPELLANT AGED IN SEA WATER



AP DEPLETION FOR PROPELLANT AGED IN PACIFIC SEA WATER



GEM II PROPELLANT IN SEA WATER CONCLUSIONS

**AP DEPLETION IN SEA WATER GIVES STRAIGHT LINE IN LOGARITHMIC
PLOT**

**WET, THEN DRIED PROPELLANT IS NOT MORE FRICTION OR IMPACT
SENSITIVE**

WET PROPELLANT IS VERY INSENSITIVE TO FRICTION AND IMPACT

**BURNING OF LONG TERM WATER SOAKED PROPELLANT EXHIBITED ONLY
SLOWER AND SLOWER FIRE INITIATION.**

NO EXPLOSIONS OR FIRE BRAND THROWING WERE OBSERVED